Feet can be different: Gradient activity and morphologically distinct templates

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Main Claim

- Different morphological templates in a language that reflect the same prosodic category can be phonologically different.
- This follows if the shape of a prosodic template node with **more activity is stronger restricted by markedness** than one with weaker activity.
- Modeled with the assumption that all linguistic symbols have **activity** that can **gradiently** differ. (Smolensky and Goldrick, 2016; Rosen, 2016)

Morphological templates

Templatic requirements about the prosodic shape of (parts of) a word

Play an important role in the productive morphology of many languages.

(1) Morphological templates in Chukchansi Yokuts (Guekguezian, 2017, 82)

a. Non-templatic forms

/wan/	wan-it	‘just gave’
/maːx/	maːx-it	‘just collected’

b. Template-demanding suffix: LH

/wan/	wanaː-la-t	‘just made X give’
/maːx/	maxaː-la-t	‘just made X collect’

Emergence of the Unmarked (=TETU) and templates

- early work in Prosodic Morphology: Explicit prosodic specifications for different templates (e.g. McCarthy and Prince, 1986; Archangeli, 1991)
- rise of OT (Prince and Smolensky, 1993/2002): Markedness constraints are obeyed in a template that can be violated outside of the template and **unmarked structure emerges**

  (McCarthy and Prince, 1994; Downing, 2006; Urbanczyk, 2006)

Example: TETU and a reduplicative σ template (Tagalog; Kennedy, 2008)

(2) Marked structure preserved outside of a template

/plato/	FAITH-IO	*CC	FAITH-BR
☞ a. plato		*	
b. pato	*!		
c. pəlato	*!		

(3) Emergence of the Unmarked for a reduplication template

σ + /plato/	FAITH-IO	*CC	FAITH-BR
a. pla ∼ plato		*!*	
☞ b. pa ∼ plato			*
c. pa ∼ pato	*!		

- the shape of the reduplicant satisfies (more) markedness constraints: Subject to a different faithfulness relation

The TETU perspective and morphologically distinct templates

- morphologically distinct templates of the same prosodic category in a single language are excluded: There is **only a single unmarked shape** for every prosodic category
- But they do exist!
  - Arabic (McCarthy and Prince, 1990; McCarthy, 1993)
  - Southern Sierra Miwok (Broadbent, 1964)
  - Chukchansi Yokuts (cf. below)
  - German (cf. below)
  - …

(4) More templates in Chukchansi Yokuts (Guekguezian, 2011, 24+25)

	Prog: LL		Gerundive: LH	
/xat/	xata-ʔ-n'	'he is eating'	xataː-ʧ'-i	'one who eats (acc.)'
/seːp/	sipa-ʔ-n'	'he is tearing (intr.)'	sipaː-ʃ'-i	'one that tears (intr.acc.)'

Plan

Theoretical Proposal: Gradient Symbolic Representations

Gradient Symbolic Representation (=GSR)

- All linguistic symbols have **activity** that can **gradiently** differ with 1=fully active. (Smolensky and Goldrick, 2016; Rosen, 2016)
- Any change in activity is a faithfulness violation – different activities result in **gradient violations of faithfulness**.
- Elements can be weakly active in the output and thus violate **markedness gradiently**.
(Zimmermann, 2017*a*,*b*; Faust and Smolensky, 2017; Jang, 2019; Walker, 2019)
- Grammatical computation modeled inside **Harmonic Grammar** where constraints are weighted. (Legendre et al., 1990; Potts et al., 2010)

GSR: Gradient Constraint Violations

(Cf. Walker (2019) for potential problems and scaling factors as an alternative)

- Weakly active segments:
  - they are **easier to delete** than 'normal' segments (=MaxS violated to a lesser degree in (5-d) than (5-c))
  - it is **costly to realize** them (=activity inserted (5-a) or weak activity in the output (5-b+c))
  - they **tolerate more marked structures** (=cluster is 'worse' in (5-a) than in (5-b)

(5) Gradient Activity=gradient constraint violations

$b_1a_1t_1\text{-}p_{0.5}$	Full! 10	MaxS 10	DepS 10	*CC 10		
a. $b_1a_1t_1p_1$			**-0.5**	**-1**	-15	Only fully active S
b. $b_1a_1t_1p_{0.5}$	**-0.5**			**-0.75**	-12.5	Faithful realization of weak S
c. $b_1a_1p_{0.5}$	-0.5	**-1**			-15	Deletion of fully active S
☞ d. $b_1a_1t_1$		**-0.5**			-5	Deletion of weakly active S

(6) Full!: Assign violation 1-X for every output element with activity X.

Arguments for GSR

1. Embedded in a general **computational architecture for cognition** (=Gradient Symbolic Computation Smolensky and Goldrick, 2016)
2. A **unified account** for different exceptional phonological behaviours:
   - liaison consonants in French (Smolensky and Goldrick, 2016)
   - semi-regularity of voicing in Japanese Rendaku (Rosen, 2016)
   - allomorphy in Modern Hebrew (Faust and Smolensky, 2017)
   - lexical accent in Lithuanian (Kushnir, 2017)
   - tone sandhi in Oku (Nformi and Worbs, 2017)
   - tone allomorphy in San Miguel el Grande Mixtec (Zimmermann, 2017*a*,*b*)
   - lexical stress in Moses Columbian Salishan (Zimmermann, 2018*c*)
   - exceptional tone (non)spreading in San Molinos Mixtec (Zimmermann, 2018*a*)
   - interaction of phonological/lexical gemination/lenition in Italian (Amato, 2018)
   - compound stress in Sino-Japanese (Rosen, 2018)
   - stress-syncope interaction in Levantine Arabic (Trommer, 2018*a*)
   - (interacting) ghost segments in Welsh (Zimmermann, 2018*b*)
   - …

Chukchansi Yokuts

Morphologically Distinct Templates in Chukchansi Yokuts

(Guekguezian, 2011, 2015, 2017)

(7) C. Yokuts: Morphologically distinct templates (Guekguezian, 2011, 24+25)

	Prog: LL		Gerundive: LH	
/xat/	xata-ʔ-n’	‘he is eating’	xataː-ʧ’-i	‘one who eats (acc.)’
/seːp/	sipa-ʔ-n’	‘he is tearing (intr.)’	sipaː-ʃ’-i	‘one that tears (intr.acc.)’

- iambic language with stress on every non-final heavy σ
  (following Guekguezian (2015); not uncontroversial)
- feet outside of template-context: H, LL, LH

(vs. the characterization in Guekguezian (2017) where only LH ‘templates’ are analysed as epiphenomenal word minimality effects)

GSR account in a nutshell

Feet with different activities

- φ with default activity φ_1 tolerates (sub-optimal) iambic feet: H, LL, LH
- progressive morpheme: a φ with activity $\varphi_{\mathbf{1.5}}$ that doesn't tolerate monosyllabic feet (=epenthesis and V shortening)
- gerund morpheme: a φ with activity $\varphi_{\mathbf{2}}$ that doesn't tolerate monosyllabic feet or light stressed σ's (=epenthesis, V-shortening, and V lengthening)

Constraints

(8)
a. DepV
Assign -X violation for every V_x that is present in the output but not the input.

b. Depμ
Assign -1 violation for every μ that is present in the output but not the input.

c. FtBin_σ
Assign -X violation for every φ_X that is not binary on the σ-level.

d. StW
Assign -X violation for every heavy σ in head-φ_X that is not in head position.

e. WtS
Assign -X violation for every head-σ in head-φ_X that is not heavy.

Foot with activity 1: Marked (H) created

(9)

seːp	FtBin$_\sigma$ 5	Depμ 3.5	DepV 3.5	StW 2	WtS 2	
☞ a. (seːp)$_{\varphi 1}$ *	-1					-5
b. (seːpa)$_{\varphi 1}$		-1	-1	-1	-1	-11
c. (sepa)$_{\varphi 1}$ **			-1		-1	-5.5
d. (sepaː)$_{\varphi 1}$		-1	-1			-7

- the markedness of the foot is tolerated:
  No V-epenthesis (or lengthening/shortening)

(*Simplification: There are no superheavy σ's and codas are moraic (Guekguezian, 2011).
**No Depμ-violations since the μ of the underlyingly long stem-V shifts to the epenthetic V.)

Foot with activity 1: Marked (LL) created

(10)

ʔade	FtBin$_\sigma$ 5	Depμ 3.5	DepV 3.5	StW 2	WtS 2	
☞ a. (ʔade)$_{\varphi 1}$					-1	-2
b. (ʔadeː)$_{\varphi 1}$		-1				-3.5

- the markedness of the foot is tolerated: No V-lengthening

Foot with activity 1.5: The progressive

(11)

seːp + $\varphi_{1.5}$	FtBin$_\sigma$ 5	Depμ 3.5	DepV 3.5	StW 2	WtS 2	
a. (seːp)$_{\varphi 1.5}$	**-1.5**					-7.5
b. (seːpa)$_{\varphi 1.5}$		-1	-1	-1.5	-1.5	-13
☞ c. (sepa)$_{\varphi 1.5}$			-1		-1.5	-6.5
d. (sepaː)$_{\varphi 1.5}$		-1	-1			-7

- the foot is ‘strong enough’ to demand epenthesis (to avoid (H)$_\varphi$) and V-shortening (to avoid (HL)$_\varphi$)
- it is still ‘too weak’ to trigger V-lengthening (to avoid (LL)$_\varphi$)

Foot with activity 2: The gerund

(12)

seːp + φ_2	FtBin$_\sigma$ 5	Depμ 3.5	DepV 3.5	StW 2	WtS 2	
a. (seːp)$_{\varphi 2}$	-2					-10
b. (seːpa)$_{\varphi 2}$		-1	-1	-2	-2	-15
c. (sepa)$_{\varphi 2}$			-1		**-2**	-7.5
☞ d. (sepaː)$_{\varphi 2}$		-1	-1			-7

- the foot is ‘strong enough’ to demand epenthesis (to avoid (H)$_\varphi$), V-shortening (to avoid (HL)$_\varphi$), and V-lengthening (to avoid (LL)$_\varphi$)

Case study: German allomorphy

Past participle prefix /gə-/ (Wiese, 2001, §4.1.2)

(13)	a.	gə–ˈzuːxt	‘searched’	gə–(ˈσ)$_\varphi$
		gə–ˈʀeːdət	‘talked’	gə–(ˈσσ)$_\varphi$
		gə–ˈha͡ɪʀaːtət	‘married’	gə–(ˈσσσ)$_\varphi$
	b.	ʃmaˈʀɔt͡st	‘freeloaded’	*gə–(σ)$_\varphi$(ˈσ)$_\varphi$
		tʀɔmˈpeːtət	‘trumpeted’	*gə–(σ)$_\varphi$(ˈσσ)$_\varphi$
		dɪskuˈtiːɐt	‘discussed’	*gə–(σσ)$_\varphi$(ˈσ)$_\varphi$

- phonologically predictable allomorphy:
  /gə–/ only if the base contains a single foot (mono-, bi-, or trisyllabic)

Nominalizing suffixes (Wiese, 2001, §4.1.3)

(14)	a.	ˈhøːflɪç–k͡aɪt	‘courtesy’	**(ˈσσ)$_\varphi$**–k͡aɪt
		gəˈleːɐzam–k͡aɪt	‘eruditeness’	(σ)$_\varphi$**(ˈσσ)$_\varphi$**–k͡aɪt
	b.	ˈʃøːn–h͡aɪt	‘beauty’	(ˈσ)$_\varphi$–h͡aɪt
		gəˈʃpant–h͡aɪt	‘tenseness’	(σ)$_\varphi$(ˈσ)$_\varphi$–h͡aɪt
		ɪntəʀəˈsant–h͡aɪt	‘interestingness’	(σσσ)$_\varphi$(ˈσ)$_\varphi$–h͡aɪt

- phonologically predictable allomorphy:
  /–k͡aɪt/ if it is adjacent to a bisyllabic foot

Two morphologically distinct templates in German

- foot adjacent to /gə–/:
  Can be mono-, bi- or trisyllabic but must be the only foot
- foot adjacent to /–ka͡ɪt/:
  Doesn't need to be the only foot but must be bisyllabic
  - ➙ the former **template hence tolerates more marked structures**
- alternative generalization: Both allomorphs must be adjacent to the main-stressed syllable
  - ➙ But how is such a subcategorization expressed in a phonological model?

GSR account in a nutshell

Preferred past participle allomorph /gə $\varphi_{1.5}$/

$\varphi_{1.5}$ licenses mono-, bi-, or trisyllabic trochees.

- additional assumption: circumfix /gə– –φ/ to ensure that this is the only φ

Preferred nominalizer allomorph /φ_2 k$\widehat{\text{aı}}$t/

φ_2 only tolerates less marked bisyllabic feet.

- listed suppletive allomorphs with a preference order
- only if realization of the preferred allomorpy is impossible, the less preferred one emerges

→ ensured in OT by PRIORITY (=PRIO; Bonet, 2004; Bonet et al., 2007)

Details: Realization of a floating φ

- must be realized/dominate material due to *FLOAT/φ–>S
  (Wolf, 2007; Zimmermann, 2017*c*)
- they cannot dominate material of their 'own' morpheme
  (ALTERNATION; van Oostendorp, 2007, 2012)
- they must be realized adjacent to the 'rest' of the morpheme due to CONTIG (15-a)
- they may never shift the (lexical) stress of the base that was optimized in an earlier stratum, due to $\text{FAITH}_{\text{STR}}$
  (Kiparsky, 2011; Bermúdez-Otero, in preparation)

(15) CONTIG (Zimmermann, 2017*c*)
Assign -1 violation for every element that does not belong to morpheme A and is not dominated by material of morpheme A but is preceded and followed by material that belongs to A or is dominated by material of A.

Nominalizer: Preferred allomorph with unmarked foot

(16)

φ_1: høːf lɪç + { φ_2: ka͡ɪt ≫ ha͡ɪt }	DEPS 10	FTBIN$_\sigma$ 5	PRIO 4	
☞ a. φ_2: høːf lɪç ka͡ɪt				0
b. φ_1: høːf lɪç ha͡ɪt			-1	-4

Nominalizer: Dispreferred allomorph with marked foot

(17)

φ_1 [ʃøːn] + { φ_2 kaɪ͡t ≫ haɪ͡t }	DEPS 10	FTBIN$_\sigma$ 5	PRIO 4	
a. φ_2 [ʃøːn kaɪ͡t]		**-2**		-10
☞ b. φ_1 [ʃøːn] haɪ͡t		-1	-1	-9
c. φ_2 [ʃøː nə] kaɪ͡t	-1			-10

Past participle: Preferred allomorph with marked foot

(18)

{ gə[φ1.5] ≫ ø } + [zuːx]φ1 + t	DepS 10	FtBin$_\sigma$ 5	Prio 4	
☞ a. gə [zuːxt]φ1.5		**-1.5**		-7.5
b. ø [zuːxt]φ1		-1	-1	-9
c. gə [zuː xət]φ1.5	-1			-10

Past participle: Dispreferred allomorph if stress is non-adjacent

(19)

$\{$ gə$_{\varphi 1.5}$ ≫ ø $\}$ + ʃma ʀɔʦ$_{\varphi 1}$ + t	FAITH$_{STR}$ 10	CONT 10	FTBIN$_{\sigma}$ 5	PRIO 4	
a. gə ʃma (ʀɔʦt)$_{\varphi 1.5}$		**-1**	-1.5		-17.5
☞ b. ø ʃma (ʀɔʦt)$_{\varphi 1}$			-1	-1	-9
c. gə (ʃma ʀɔʦt)$_{\varphi 1.5}$	-1				-10

Summary

Summary

- The assumption of GSR predicts morphologically distinct templates: Within one language, the same prosodic category can license **different degrees of markedness** depending on its activity
- This claim crucially relies on activity in the output and hence **gradient markedness violations**
- GSR predicts an inventory of prosodic templates with **implicational markedness differences** for every language, borne out in the typology of morphologically distinct templates.

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Appendix: More on Chukchansi Yokuts

- only stems with a single V undergo template changes, the (rarer but still existent) stems with two vowels never change (Guekguezian, 2017, 93)
- falls out in the present account if
  - underlying vowels cannot be lengthened (=high-ranked DEPAL constraint penalizing the insertion between μ's and V's if one was underlying; epenthetic V's are exempt (?))
  - vowels can only be shortened if their μ can be reassociated (to an epenthetic V; cf. points above)

Appendix: GSR and true gradience

- no inherent restriction on gradient contrasts within a language
  - 3 types of segments in Welsh:
    $/k_{1.0}/$ - $/r_{0.6}/$ - $/g_{0.2}/$
  - 3 types of association lines in Oku (Trommer and Zimmermann, 2018):
    $/H\!-_{1.0}\!\bullet/$ - $/H\!-_{0.6}\!\bullet/$ - $/H\!-_{0.4}\!\bullet/$
  - 4 (derived) segment types in Levantine Arabic (Trommer, 2018*b*):
    $/i_{0.7}/$ - $/i_{0.6}/$ - $/i_{0.5}/$ - $/i_{0.3}/$
  - 5 types of feet in Moses Columbian Salish (Zimmermann, 2018*c*):
    $/\varphi_{1.0}/$ - $/\varphi_{0.9}/$ - $/\varphi_{0.8}/$ - $/\varphi_{0.6}/$ - $/\varphi_{0.4}/$
- vs. alternatives
  - most accounts based on autosegmental defectivity that only allow a binary distinction into [$\pm$defective] (e.g. Hyman, 1985; Noske, 1985; Kenstowicz and Rubach, 1987; Sloan, 1991; Yearley, 1995; Tranel, 1996; Zoll, 1996)
  - accounts that adopt 'strength' as a binary division
    (Inkelas, 2015; Vaxman, 2016*a*,*b*; Sande, 2017)

GSR: Surface activity and phonetic interpretation

- phonetic gradience in phonology:
  - subphonemic gradience in word-final devoicing, nasal place assimilation, flapping (Braver, 2013, e.g.)
  - vowel harmony is gradient; gets weaker the farther it spreads (McCollum, 2018)

➙ a convincing example would be one where phonetic gradience and exceptional phonological behaviour stemming from underlying weakness coincide

Open Question: The source for strength in GSR

- lexical contrast for phonological elements
- lexical contrast for whole morphemes (Faust and Smolensky, 2017)
- **derived in the phonology**:
  - 'Gradient representations can mature or decay across layers' (Trommer, 2018*b*)
  - stress strengthens elements (Faust and Smolensky, 2017; Amato, 2018; Trommer, 2018*b*)
  - floating strength strengthens elements (Amato, 2018)
  - fission is weakening/distribution of activity (Zimmermann, 2019)
  - certain features have an inherent strength and feature change thus implies strength adjustment (Walker, 2019)